ECOLOGY

- ***Ecology*** =
  - Scientific study of interactions among organisms and their environment

- ***Biotic factors*** =
  - Living components in the environment
  - Ex: Other organisms that serve as food, predators, competition, etc.

- ***Abiotic factors*** =
  - Chemical and physical components of the environment (nonliving)
  - Ex: Sunlight, temperature, precipitation, pH, salinity, soil type, etc.

- ***Species*** =
  - Group of similar organisms that can breed and produce fertile offspring
- ***Population*** =
  - Group of individuals of the same species that live in the same area
- ***Community*** =
  - Group of different, interacting species that live in the same area

- ***Ecosystem*** =
  - All of the organisms that live together, interacting with their physical environment
- ***Biome*** =
  - Group of ecosystems that share similar climates and typical organisms
  - Grouped geographically
- ***Biosphere*** =
  - Part of Earth in which life exists, including land, water, and atmosphere

Biomes

Biome	Soil	Climate	Plants and Animals
Tropical Rain Forest	•Thin •Nutrient poor	•Hot •Very wet (>95in/yr)	•Home to more species than others combined •Canopy and understory with large leaves •Active animals
Tropical Savanna	•Some nutrients •Frequent fires	•Hot •Dry season and wet season	•Tall grasses; isolated trees •Migrating, grazing, burrowing animals
Desert	•Thin •Porous •Nutrient poor	•Hot days; cold nights •Very dry (<10in/yr)	•Cacti •Nocturnal animals

Biome	Soil	Climate	Plants and Animals
Temperate Grassland (AKA Plains and Prairies)	•Fertile •Deep and nutrient rich	•Warm/hot summers; cold winters •10-60 in precip/year (mostly snow)	•Lush grasses •Grazing and burrowing animals
Temperate Forest (AKA Deciduous Forest) *Our Biome!	•Fertile •Nutrient rich and well developed	•Warm summers; cold winters •30-80 in precip/year	•Deciduous and coniferous trees •Hibernating and migrating animals

Biome	Soil	Climate	Plants and Animals
Coniferous Forest (AKA Taiga, Boreal Forest)	•Acidic	•Short summers; long, cold winters •15-20 in precip/year (sticks around)	•Tall redwoods; conifers •Animals with extra insulation
Tundra	•Permafrost •Thin and perpetually frozen	•Long, cold, dark winters with strong winds •Low precip (<5 in/yr but sticks around)	•Mosses •Animals with small extremities

Other Land Areas

- Mountain Ranges
  - Conditions vary with elevation
- Polar Ice Caps
  - Border tundra
  - Cold year round
  - Few plants
  - Covered with thick ice sheets

Aquatic Ecosystems

Water Depth

- ***Photic zone*** =
  - Sunlit region near surface
  - Photosynthesis can occur
- ***Aphotic zone*** =
  - Dark layer where sunlight does not penetrate
  - No photosynthesis
- ***Benthic zone*** =
  - Region where organisms live attached to or near bottom of lakes, streams, or oceans

Freshwater Ecosystems

- ***Lotic*** =
  - Flowing water
  - Ex: Rivers and streams
- ***Lentic*** =
  - Standing water
  - Ex: Lakes and ponds
- ***Wetlands*** =
  - Water covers soil for at least part of the year
  - Serve as breeding grounds, water purifiers, flood prevention
  - Ex: Bogs, marshes, swamps

Estuaries

- ***Estuary*** =
  - Wetland formed where a river meets the sea
  - Mixture of fresh and salt water
  - Affected by tides
  - Typically shallow
  - Spawning and nursery grounds for many species
  - Plants must be salt tolerant!
    - Ex: Mangrove swamp

Marine Ecosystems

- ***Intertidal zone*** =
  - Between low and high tide
  - Submerged in saltwater and exposed to air and sunlight
- ***Coastal ocean*** =
  - From low-tide to edge of continental shelf
  - Brightly lit
  - Lots of nutrients
  - Includes kelp forests and coral reefs
- ***Open ocean*** =
  - From edge of continental shelf outward
  - More than 90% of ocean area

Energy Flow

Trophic Levels

Autotrophs = ("self nourish")

•Organisms that make their own food by capturing energy from sunlight or chemicals

•Examples

- ***Chemotrophs*** =
  - Organisms that produce energy from chemical sources
- ***Phototrophs*** =
  - Organisms that produce energy from light
    - *IE- Photosynthesis*

- Autotrophs are also known as ***producers***
  - Note- Not all plants are producers!
    - Examples
      - Indian pipe (no chlorophyll)
      - Venus fly trap (eats insects)

Heterotrophs = ("different nourish")

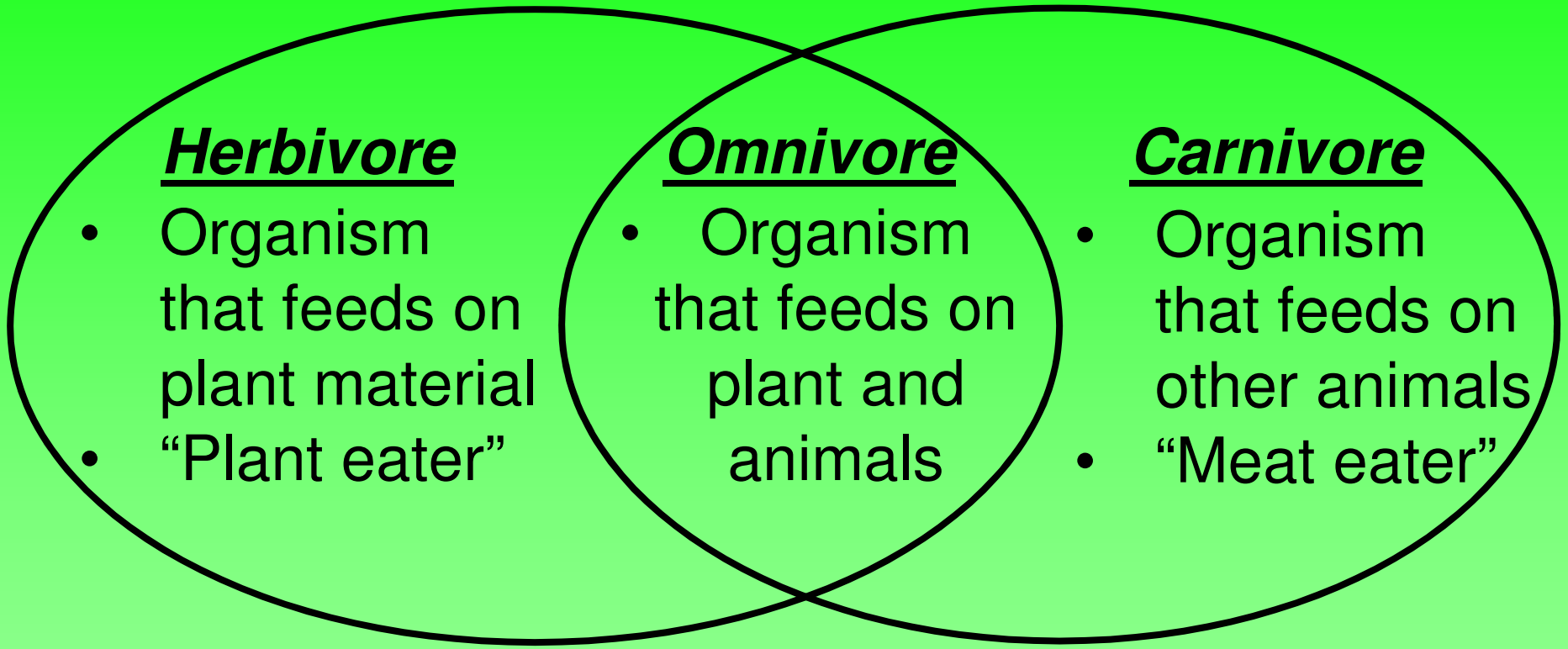
- Organisms that obtain food by consuming other organisms

- Examples
  - ***Consumers*** =
    - Organisms that feed on other live organisms for carbon and energy

- ***Primary consumers*** =
  - Feed directly on producers
  - Ex: elephants, rabbits, cows
- ***Secondary consumers*** =
  - Feed on primary consumers
  - Ex: fox, dog, hawk
- ***Tertiary consumers*** =
  - Uppermost level in a food web that feeds on secondary consumers
  - Ex: hawks, tigers, sharks

- ***Detritus Feeders*** =
  - Organisms that obtain their nutrients and energy by feeding on remains of dead organisms
  - Ex: earthworms
  - Note: Decomposers are specialized detritus feeders that chemically break down organic matter
    - Ex: bacteria and fungi
  - Recycle nutrients!

Types of Heterotrophs



Herbivore

- Organism that feeds on plant material
- "Plant eater"

Omnivore

- Organism that feeds on plant and animals

Carnivore

- Organism that feeds on other animals
- "Meat eater"

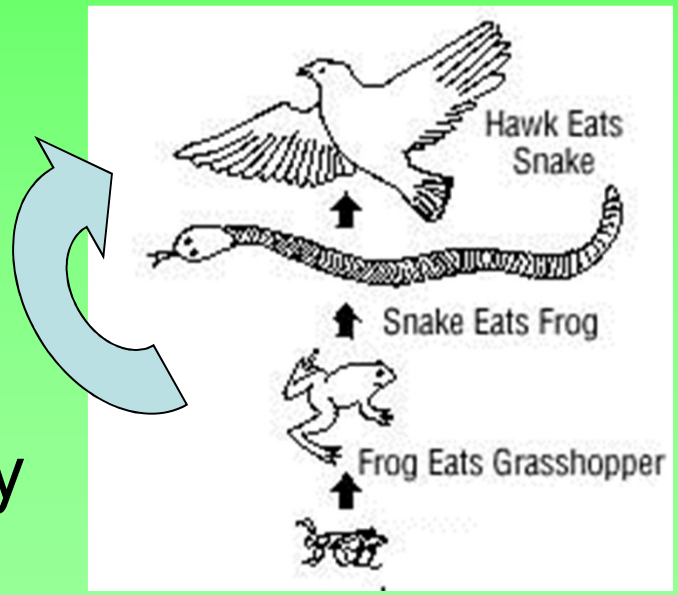
Detritivore

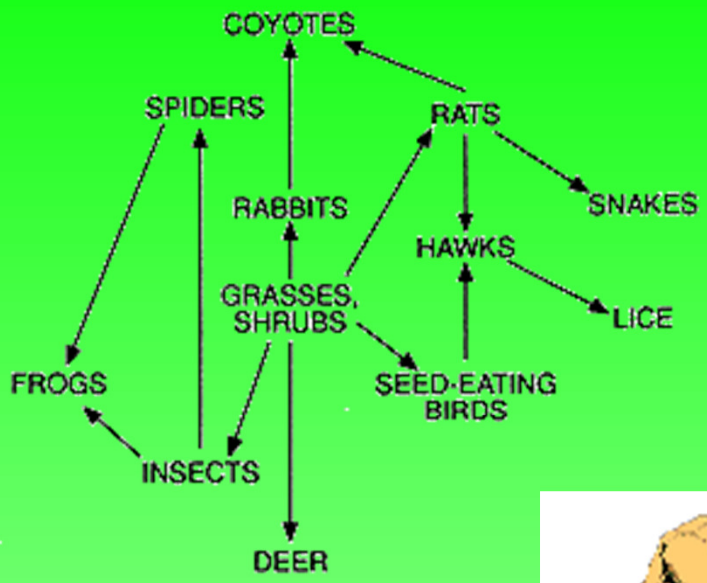
- Organism that feeds on dead and decaying plant or animal material
- IE- Detritus feeders and decomposers

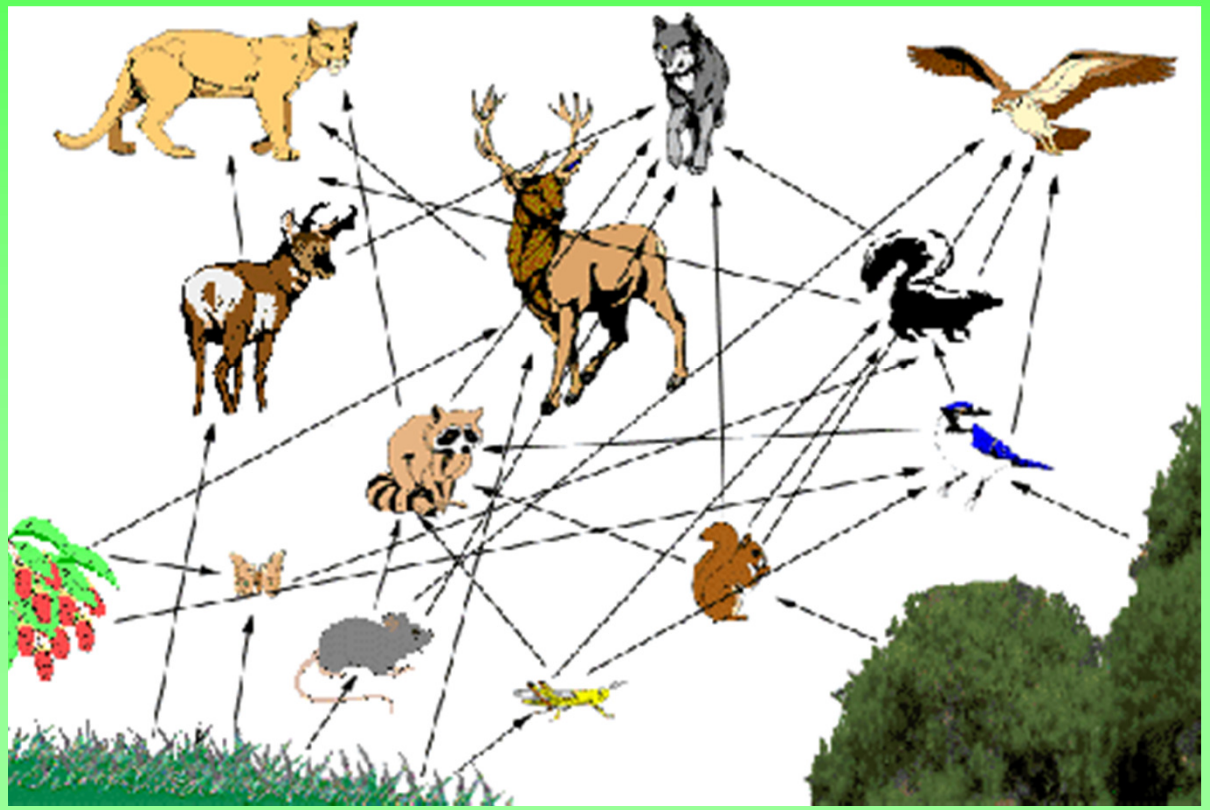
- ***Predator*** =
  - An animal that attacks and feeds upon another animal
- ***Prey*** =
  - An animal that is killed and eaten by another animal
- ***Scavenger*** =
  - An animal that feeds on organisms that are already dead
  - Ex: Vultures, hyenas, raccoons

Food Webs

- ***Food chain*** =
  - Organisms transfer energy by eating and being eaten
  - Seldom exist in isolation
- ***Food web*** =
  - Combination of all the feeding relationships that exist in an ecosystem
  - Arrows show flow of energy



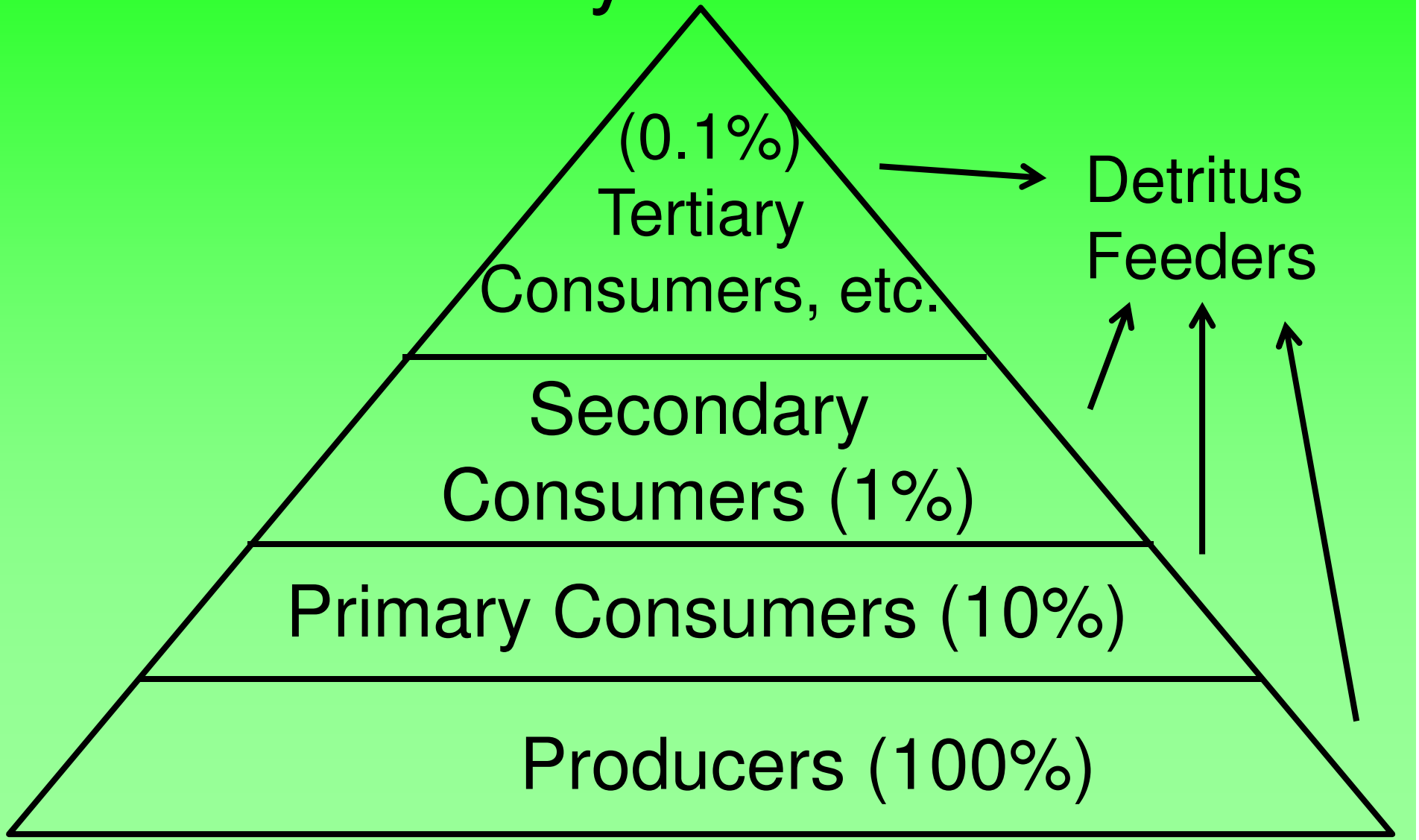

COYOTES
SPIDERS
RATS
RABBITS
SNAKES
HAWKS
GRASSES, SHRUBS
LICE
FROGS
SEED-EATING BIRDS
INSECTS
DEER



- All food chains/webs must start with producers!!!
- Energy flows in a one-way direction through ecosystems
  - It is not recycled
  - It must be continually re-supplied by sunlight!!!
- Energy is converted from sunlight to glucose by photosynthetic organisms
  - Light + water + carbon dioxide → glucose + oxygen
  - Light + ^{6} H_2O + ^{6} CO_2 → $C_6H_{12}O_6$ + ^{6} O_2

- Only 10% of the energy is passed through food webs from organism to organism
  - Some is broken down to do work
  - Some is lost as heat
- There has to be more energy at the bottom to support the organisms at the top
- ***Biomass*** =
  - Total amount of living tissue within a given trophic level

Biomass and Energy Pyramids



Biogeochemical Cycles

Water Cycle

1. Water enters atmosphere through
   - ***Evaporation*** = liquid to gas
   - ***Transpiration*** = from leaves of plants
2. Clouds form through
   - ***Condensation*** = gas to liquid
3. Water returns to Earth's surface through
   - ***Precipitation*** = rain, snow, sleet, hail
4. Water flows along surface as ***runoff***
   or becomes part of groundwater through
   - ***Infiltration*** = water absorbed into soil
5. Water re-enters atmosphere

Carbon and Oxygen Cycles

- Photosynthesis
  - Plants absorb carbon dioxide to produce carbohydrates
  - Oxygen is released
- Carbohydrates pass through food webs to consumers
- Respiration
  - Oxygen is used
  - Carbon dioxide is released
- Decomposers break down dead organisms and release carbon to environment

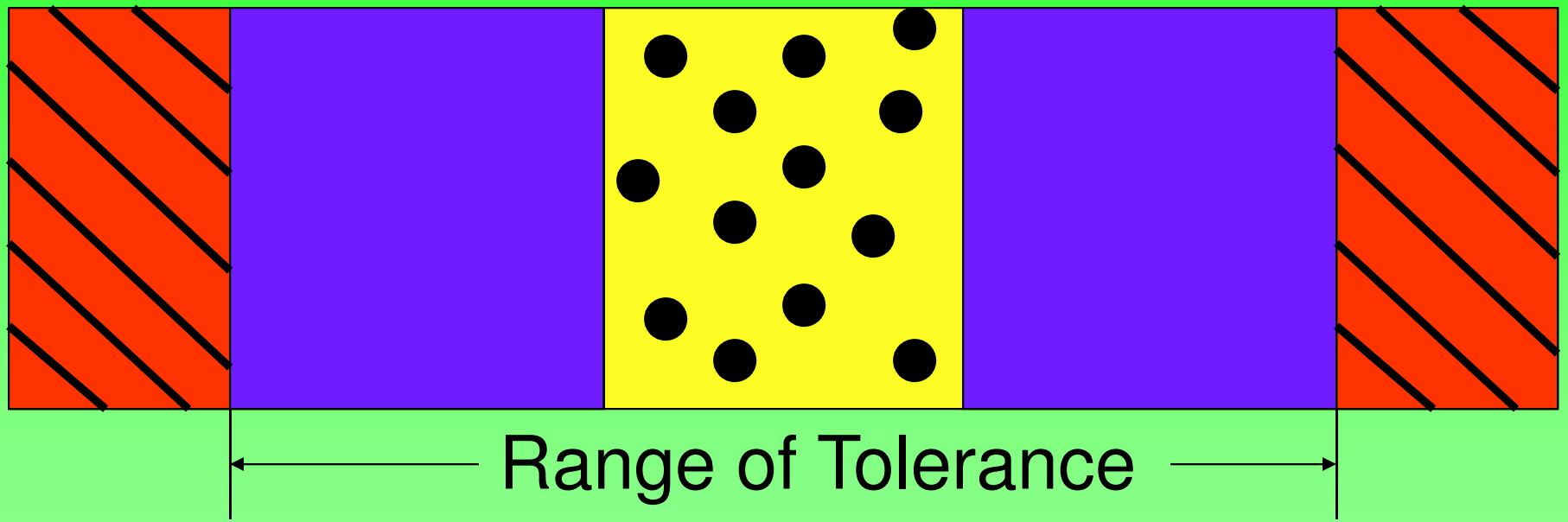
Nitrogen Cycle

1. Bacteria absorb nitrogen gas and convert it into more usable form through ***nitrogen fixation***
2. Primary producers use this nitrogen to make proteins and nucleic acids
3. Passed through food webs
4. Released in waste and decomposing matter
5. Other bacteria convert it back into nitrogen gas through ***denitrification***

- Runoff from fertilized fields may add nitrogen and phosphorus to bodies of water
- Causes algal blooms
- Algae block light, killing underwater plants
- Bacteria use up oxygen as they break down excess detritus
- Fish suffocate and die!

Interactions

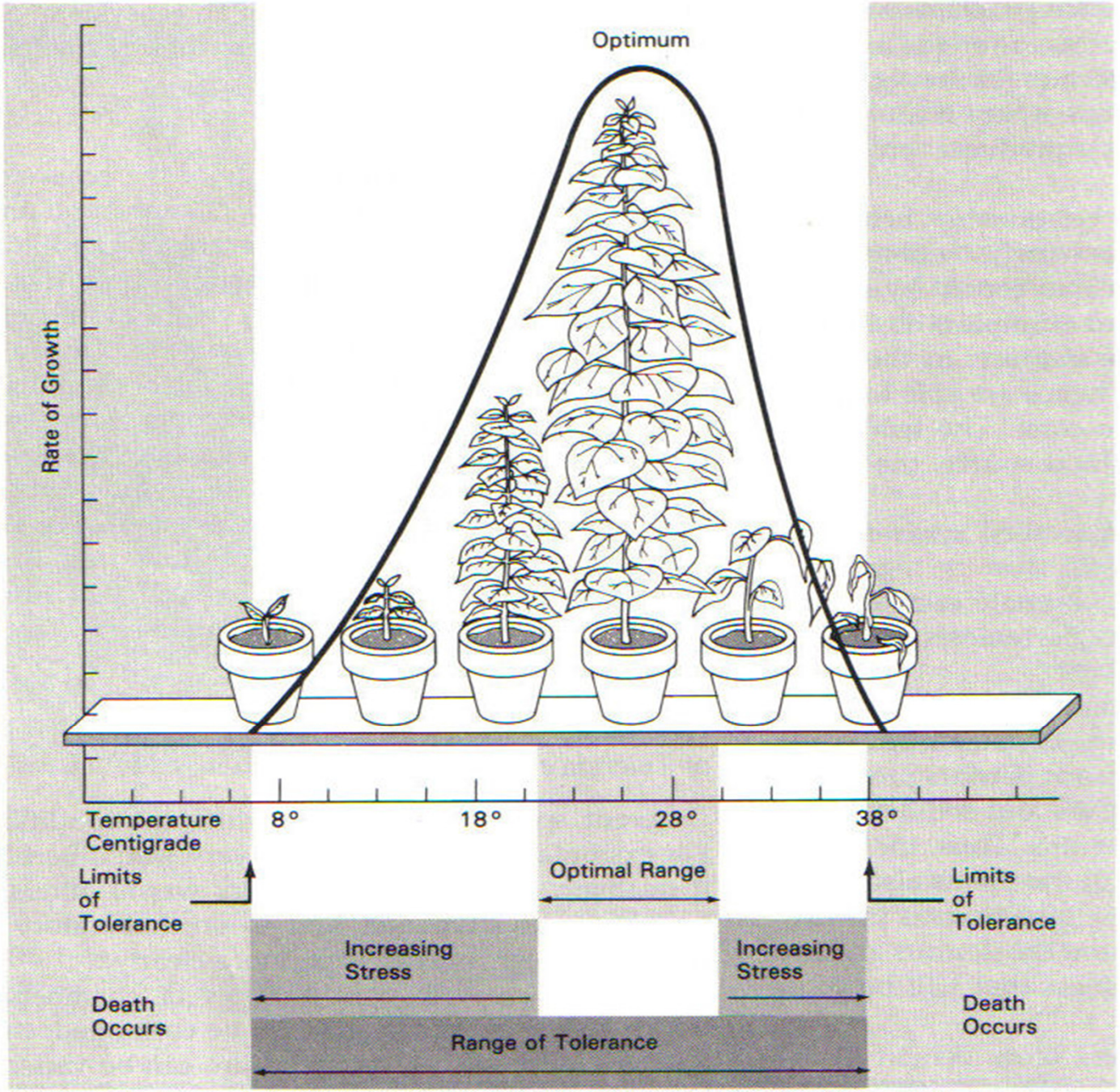
- ***Range of tolerance*** =
  - Range of environmental factors in which organisms can survive and reproduce



Optimal Range = Supports maximum growth

Zones of Stress = Conditions are tolerable but not optimal

Beyond Limits of Tolerance (Death Occurs)


Optimum
Rate of Growth
Temperature
Centigrade
8°
18°
28°
38°
Limits
of
Tolerance
Optimal Range
Limits
of
Tolerance
Increasing
Stress
Increasing
Stress
Death
Occurs
Range of Tolerance
Death
Occurs

- ***Habitat*** =
  - General place where organism lives
  - Determined by range of tolerance
- ***Niche*** =
  - Range of conditions in which organism lives and the way it uses those conditions
    - Food, light, water, shelter, etc.
    - Mating, nesting, feeding, etc.

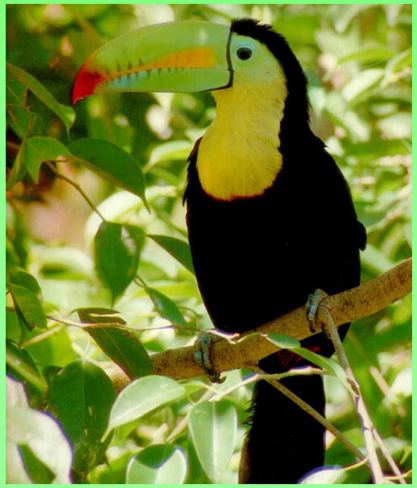
Competition

- ***Competitive exclusion principle =***
  - No 2 species can occupy the same niche in the same habitat at the same time
  - One species will eventually exclude the other

Cardinals eat sunflower seeds

Woodpeckers eat insects in trees

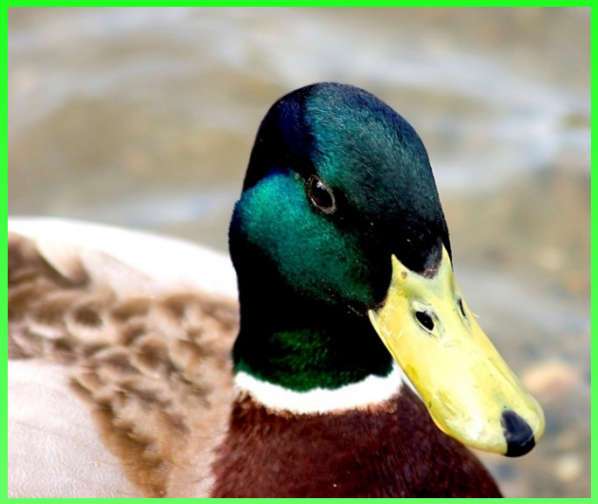
House sparrows eat seeds and insects



Toucans eat fruit

Cassowary- Eats fruit off of ground

Eagles eat meat



Ducks strain insects

Kiwi digs for worms
(Uses smell)

Loons dive for fish

Keystone

- ***Keystone species*** =
  - A species whose role is essential for the survival of many other species in an ecosystem
- Removing keystone species decreases species diversity
- Species Diversity = Ecosystem Stability

- Examples of keystone species:
  - Starfish
    - Feed on mussels
    - Allows barnacles, anemones, and other organisms to live on rocks
    - Starfish removed = other organisms crowded out
  - Otters
    - Feed on urchins
    - Urchins feed on kelp
    - Otters removed = sea birds and other organisms lost kelp habitat

Symbiosis

- ***Symbiosis*** =
  - Situation in which two different species live closely together
  - Types
    - Parasitism
    - Mutualism
    - Commensalism

- ***Parasitism*** =
  - One organism gets nutrients by taking them from another organism
  - One organism benefits and the other is harmed
  - Unlike predators
    - Typically do not kill their hosts
    - The host provides a home and nutrients
  - Examples
    - Viruses, many bacteria, tapeworm, leeches, mistletoe

PARASITISM

- ***Mutualism*** =
  - Relationship in which both species benefit from each other
  - Examples
    - Clownfish and anemones
    - Flowers and bees (pollination)

MUTUALISM


Alfred B. Maclay Gardens State Park
FloridaStateParks.org
Photo by Mark Ferrulo

- ***Commensalism*** =
  - One species benefits and the other is neither helped nor harmed
  - Examples
    - Decorator crabs
    - Remora and shark
    - Whales and barnacles
    - Birds and nest in tree

COMMENSALISM

Type of Symbiosis	A	B
PARASITISM	+	-
MUTUALISM	+	+
COMMENSALISM	+	0

Succession

- ***Succession =***
  - Change in the species that occupy an ecosystem
- Some species invade and become more numerous
- Others decline in population and disappear

- Caused by a change in one or more factors that benefits some species at the expense of others
  - Biotic or abiotic
  - Natural or human disturbances
    - Climate change
    - Introduction of nonnative species
    - Pollution
    - Fires

- ***Primary succession*** =
  - Occurs in an area in which no trace of a previous community is present
  - Ex: Volcanic eruptions or retreating glaciers
  - ***Pioneer species*** =
    - First species to colonize barren areas

- ***Secondary succession*** =
  - Occurs in area that was only partially destroyed by disturbances
  - Ex: Wildfires, hurricanes, logging, farming

- ***Climax ecosystem*** =
  - Populations of all organisms are in balance with each other and with existing abiotic factors
  - The last stage in ecological succession

- Ecosystems may or may not recover human-caused disturbances!

Population Growth

- ***Population density*** =
  - Number of individuals per unit area
- Population distribution
  - Random
  - Uniform
  - Clumped
- Factors affecting population growth
  - Birthrate vs death rate
  - Immigration (in) vs emigration (out)

- Exponential Growth
  - The larger a population gets, the faster it grows
  - J-shaped growth curve
    - Population growth under optimal conditions
    - Eventually crashes
- Logistic Growth
  - Growth slows and then stops following a period of exponential growth
  - S-shaped growth curve
    - Population stabilizes at ***carrying capacity*** =
      - Maximum number of individuals of a species that can be supported by that environment

- ***Limiting Factors*** =
  - Control growth of population
  - Determine carrying capacity
- Density-Dependent Limiting Factors
  - Competition
  - Predation
  - Herbivory
  - Parasitism and disease
- Density-Independent Limiting Factors
  - Unusual weather
  - Natural disasters
- Introduced species may not encounter expected limiting factors
  - Could result in exponential growth!

Population Density

- Will be greatest
  - When all conditions are optimal
- Will decrease but still be present
  - When any factors are in zones of stress

Species will not exist

- When even one factor is outside limits of tolerance

Remember, factors that limit growth and reproduction are ***limiting factors***

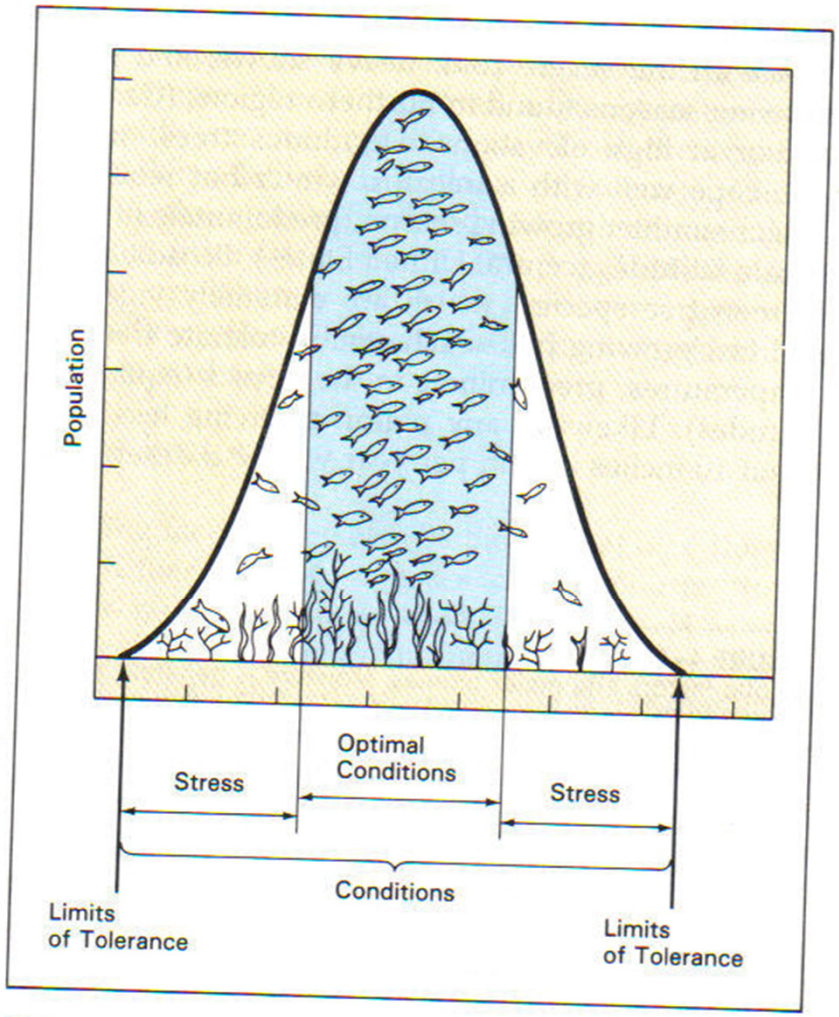


FIGURE 1–17
Individuals will be most abundant where conditions are optimal and less numerous as conditions are less favorable. Individuals will not be found beyond the limits of tolerance.

Population Density